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(54) Parallel displacement single axis vibration absorber

(57) A vibration absorber or isolator includes parallel flexible beams (1, 2) of rectangular cross section connected between parallel mounting plates (3, 4) to permit parallel translation of the mounting plates in substantially one parallel direction only thereby permitting the vibration absorber to absorb relative induced motion or vibration in one preferred direction (Y) only while retaining relative stiffness for control in the remaining two coordinate directions (X, Z) as well as restraining torsional twist.

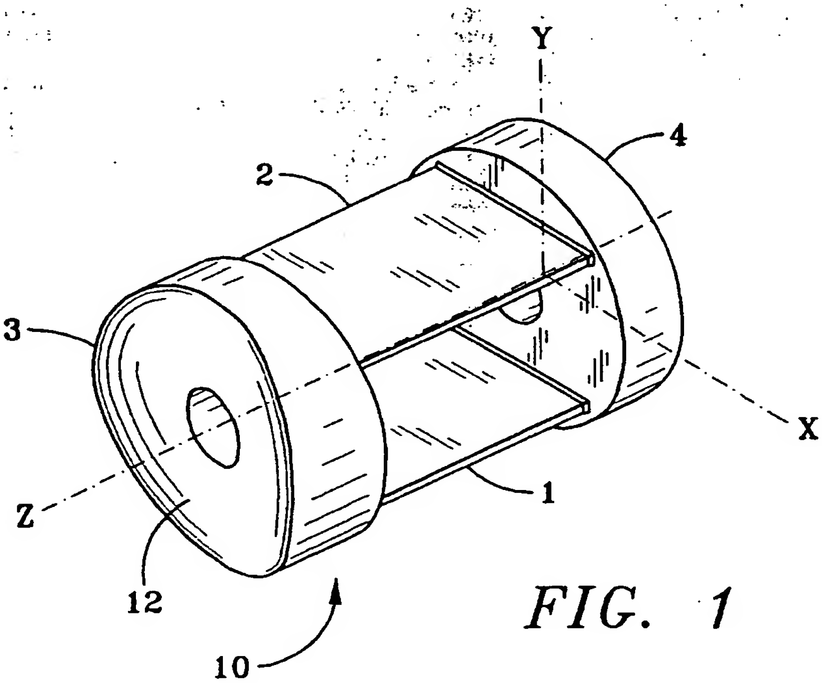

FIG. 1

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Description

This invention relates generally to vibration absorbers or isolators and more particularly to a device for isolating vibration in a single direction for power tool application. Power tools typically have working parts that rotate or reciprocate. These motions can cause vibrations, some of which may be delivered to an operator particularly in the case of hand held tools. Various means have been employed to reduce the vibration transmitted to the user. In many cases the approach taken has been to soften the tool handle(s). While this approach can significantly reduce higher frequency vibrations, in some cases the relatively large static displacements associated with the soft handle reduce the operator's ability to control the tool. In addition, the handle is typically softened in such a way that motion of the handle in all directions relative to the tool is affected with an attendant loss of precise tool control.

According to the present invention there is provided a parallel displacement single axis vibration absorber comprising a first base member and a second base member, each of said first and second base members being provided with a surface spaced apart from and parallel to each other defining a Z direction and distance, a pair of parallel elongate flexible beams spaced apart and interconnecting said first base member and said second base member in a parallel elongate direction defining the X direction, and said pair of elongate beams each being provided with a perpendicular Y dimension substantially smaller than the X dimension of said flexible beams, whereby said first base member is substantially free to translate in a Y direction relative to said second base member and substantially restrained in relative motion between said first base member and said second base member in both the X and Z directions.

The present invention provides a means of (a) changing the mode of handling deflection in such a way as to give the operator more control over the tool; and (b) isolating the vibration most significantly in a single direction, again, enhancing operator control. Additionally, several such devices could be used within a power tool to isolate moving parts from the tool body or selectively adding one or more additional selected direction for isolating vibration.

In one embodiment a single screw mounting permits rapid orientation of the vibration isolator to permit tuning by orientation selection for various applications.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

Fig. 1 shows a parallel displacement single axis vibration isolator;

Fig. 2 shows a schematic application of the vibration isolator of Fig. 1 in a typical hand held power tool;

Fig. 3 shows another embodiment of the vibration isolator of Fig. 1 including a means for vibration dampening;

Fig. 4 shows the vibration isolator installed in a typical power tool handle; and

Fig. 5 shows a combination of application of the vibration isolator in both a power tool handle and as a means for isolating the power tool motor from the housing.

One embodiment of a parallel displacement single axis vibration absorber or isolator 10 is shown in Fig. 1. The isolator includes parallel flexible beams 1 and 2 which are fastened to common end plates 3 and 4 at each end. The benefits of the device are derived from the characteristics of the isolator's beams 1 and 2 when subjected to vibratory loading. Defining a Cartesian coordinate system, as shown in the end plate 4 of Fig. 1, when one end of the device is forced downward (in the Y direction), the mode of deflection is such that very little relative angular motion of the end plates occur. The relative motion is primarily translatory in the Y direction. Depending on the beam thickness, depth and length, the isolator can be designed to be relatively soft in the Y direction.

Depending on the choice of beam thickness, depth and length, the isolator can have high stiffness when being forced in the X or Z directions. This is true because the beams 1 and 2 are substantially relatively deeper in the X direction and act as columns in the Z direction. By additionally choosing an appropriate separation distance between beams 1 and 2, the ability to support moment loads about the X axis can be tailored so that the translatory behaviour is preserved.

Fig. 2 shows an application of the single axis vibration isolator 10 mounted in a conventional power tool such as, for example, a rotatory grinder 20. The grinder is provided with an auxiliary handle 21 and a control handle 22. The auxiliary handle 21 is shown in cut-away to show the mounting of the isolator. As shown, the base end plate 4 is pressed into a close fit cylindrical inside portion of the handle 25 and is retained there by compression or other suitable means.

The end plate 3 is shown attached to a boss 6 on the side of the tool housing 7 and is retained there by means of a screw 8 or the like. The end plate 3 may be rotated relative to the boss 6 and secured in that desired orientation by means of the screw 8. This is a useful feature in that it permits selecting the ideal orientation relative to the tool for absorption of operation induced vibrations. Vibration direction may vary substantially due to the nature of the grinder use. The handle 25 is provided with an expanded portion 23 which permits clearance about the end plate 3 and boss 6 thereby permitting the plate 3 to translate relative to the plate 4 and handle 21.

Fig. 3 shows another embodiment of the isolator. In order to reduce resonance in the isolator, an appropriate damping material such as, for example, a rubber isolator 15, may be inserted or cast in place as shown between the parallel beams. It should also be understood that rubber or similar damping material may be cast or placed in any of the open or void space between the end plates 3 and 4 to accomplish damping. Options of damping vary from completely encasing the isolator in a damping material to inserting a damper in such a way that it does not directly interact with the beams.

Fig. 4 shows an assembled handle 21 with the vibration isolator in place. To install the handle, (referring to Fig. 2), the screw 8 is inserted through a hole 11 into a smaller diameter hole 9 and screwed into a suitable thread provided in the boss 6. In the event a single orientation of the handle is desired, the end plate 3 may be cupped or grooved on its end face 12 to mate with a corresponding crown or groove on the boss 6.

Fig. 5 shows another possible use of the vibration isolator installed in multiple pairs to mount a power tool motor 30 in a power tool housing 7. The motor is shown driving a typical cup type grinding wheel 35 which in turn interacts with work (not shown). The vibration isolators 10 are shown in an orientation which permits the substantial vertical movement of the motor 30 as indicated by the double arrow on the motor. This reduces the amount of force transmitted vertically to the housing as shown by the smaller double arrows near the top of the housing. In addition, an auxiliary handle 21 is shown mounted to the housing 7. As previously described, the reduced vertical vibratory force transmission is indicated by the even smaller double arrows indicated in the end plate 4.

Because the deflection of the isolator is primarily translatory in nature, the user's hand, which may be located some distance from the isolator, need not travel the additional distance associated with an isolator that is rotary in nature. This contrasts with the typical handle isolation schemes which tend to rotate about a point. The present isolator lends to having much greater stiffness in directions other than the primary isolation direction. This is again in contrast with typical prior art isolation systems. Both of these characteristics enhance the operator's ability to control the power tool while still reducing the vibration in the direction where isolation is required.

Claims

1. A parallel displacement single axis vibration absorber comprising a first base member (3) and a second base member (4), each of said first and second base members being provided with a surface spaced apart from and parallel to each other defining a Z direction and distance, a pair of parallel elongate flexible beams (1, 2) spaced apart and interconnecting said first base member (3) and said second base member (4) in a parallel elongate direction defining the X direction, and said pair of elongate beams (1, 2) each being provided with a perpendicular Y dimension substantially smaller than the X dimension of said flexible beams, whereby said first base member is substantially free to translate in a Y direction relative to said second base member and substantially restrained in relative motion between said first base member and said second base member in both the X and Z directions.

2. An absorber according to claim 1, wherein said first base member and said second base member are spaced apart circular discs.

3. An absorber according to claim 1 or 2, wherein said pair of beams (1, 2) are of rectangular cross-section each having a length substantially greater than its thickness.

4. An absorber according to claim 1, 2 or 3, wherein the surfaces of said first base member and said second base member and the beams form an included parallelogram.

5. An absorber according to any one of the preceding claims, wherein said first base member (3) is provided with a means for attachment to a vibration source (20) and said second base member (4) is provided with a means for attachment to a gripping handle (21).

6. An absorber according to any one of the preceding claims and being installed between a tool housing (7) and a handle (21).

7. An absorber according to any one of the preceding claims, wherein said vibration absorber is further provided with a means (15) for vibration dampening.

8. An absorber according to claim 7, wherein said vibration dampening means comprises a rubber insert (15).

9. An absorber according to claim 7, wherein said vibration dampening means comprises a moulded vibration absorbing material incorporated in said vibration absorber.

10. An absorber according to any one of the preceding claims and being installed as a vibration absorber between a power tool, power source and a housing thereabout.

11. An absorber according to any one of the preceding claims and being installed in combination with a plu-

rality of single axis vibration absorbing devices to define a unit directional series path of vibration absorption.

12. An absorber according to any one of claims 1 to 10 and being installed in series at different orientations to define a multipath linear direction of vibration absorption.

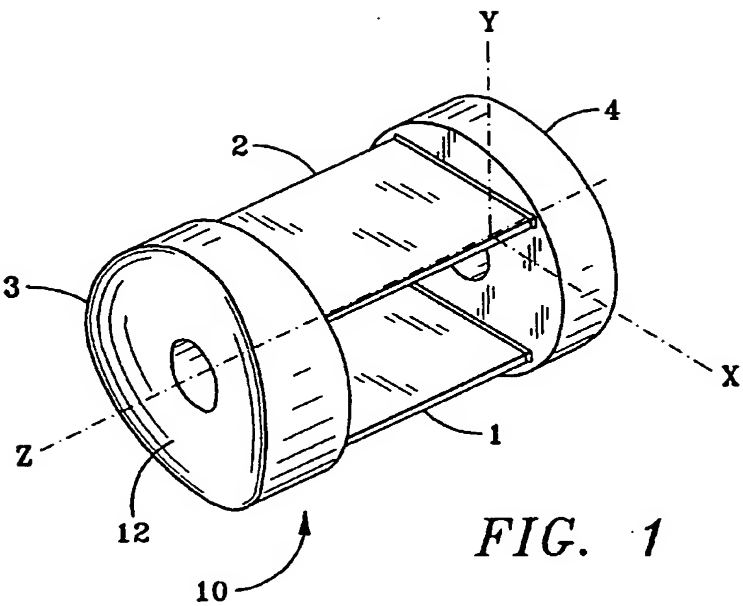

FIG. 1

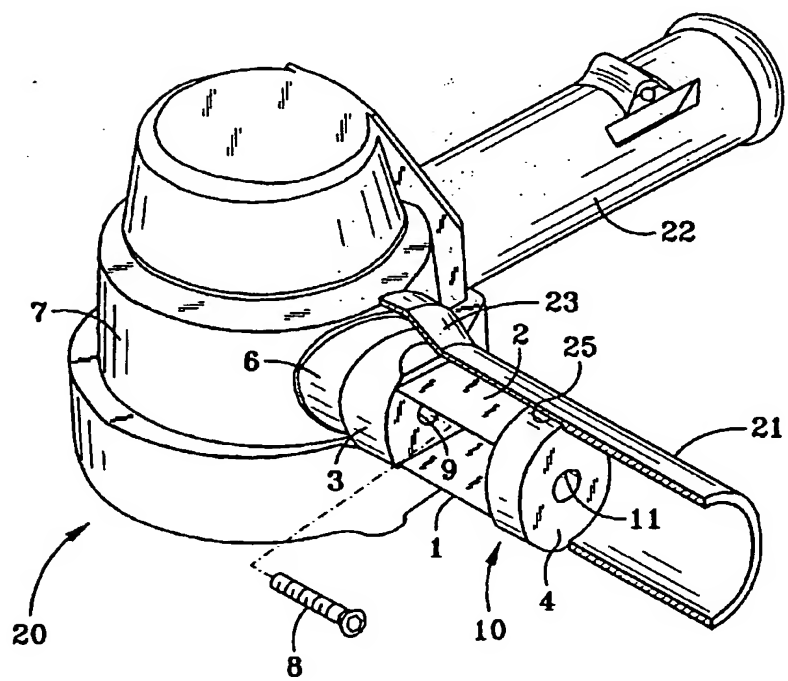

FIG. 2

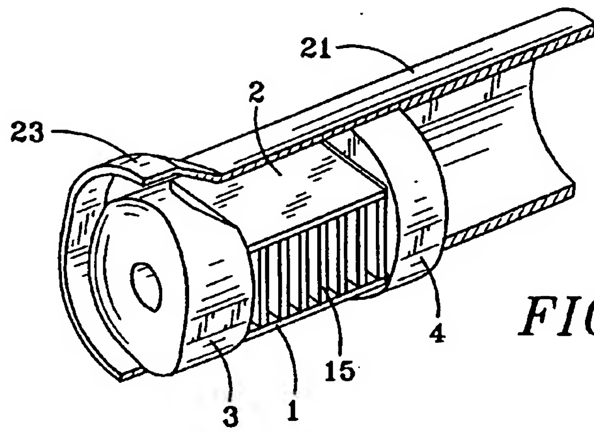

FIG. 3

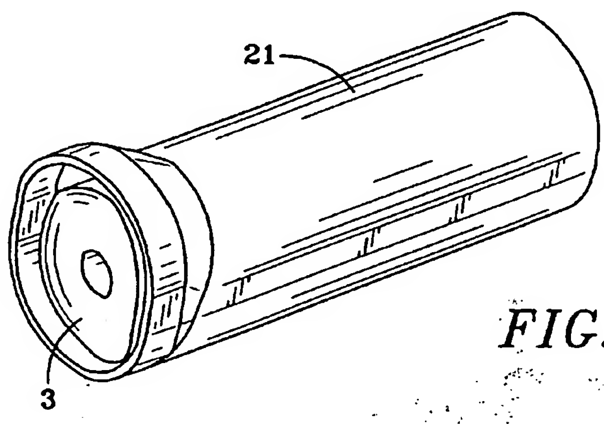

FIG. 4

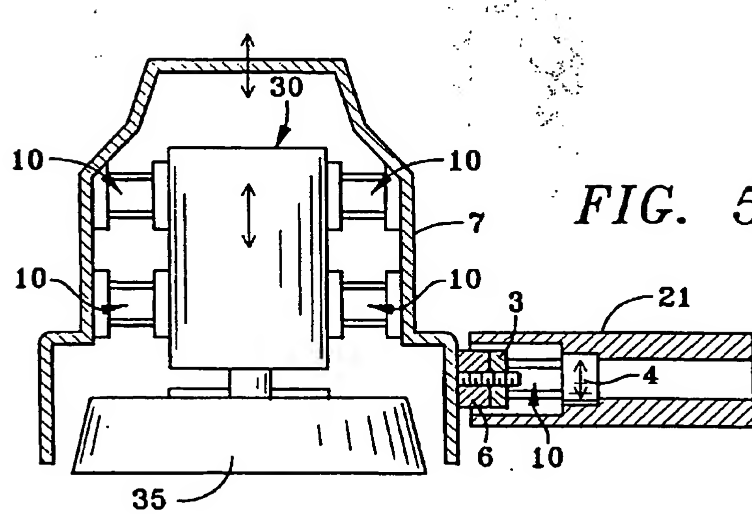

FIG. 5